



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|------------------------|------------------|
| 10/616,097 | 07/08/2003 | Zhi-Wen Sun | AMAT/8241/CMP/ECP/RKK | 1645 |
| 44257 7590 02/28/2007 PATTERSON & SHERIDAN, LLP 3040 POST OAK BOULEVARD, SUITE 1500 HOUSTON, TX 77056 | | | EXAMINER WONG, EDNA | |
| | | | ART UNIT 1753 | PAPER NUMBER |

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
|--|------------|---------------|
| 3 MONTHS | 02/28/2007 | PAPER |

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/616,097

Applicant(s)

SUN ET AL.

Examiner

Edna Wong

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 January 2007.
2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 8-10,20-22,31-33 and 37-59 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5) ☐ Claim(s) _____ is/are allowed.
6) ☒ Claim(s) 8-10,20-22,31-33 and 37-59 is/are rejected.
7) ☐ Claim(s) _____ is/are objected to.
8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

This is in response to the Amendment dated January 17, 2007. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Response to Amendment

Claim Rejections - 35 USC § 112

Claims **39-41, 44 and 52** have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The rejection of claims 39-41, 44 and 52 under 35 U.S.C. 112, second paragraph, has been withdrawn in view of Applicants' amendment.

Claim Rejections - 35 USC § 103

I. Claims **8-9 and 37-44** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1).

The rejection of claims 8-9 and 37-44 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. and Wang et al. is as applied in the Office Actions dated May 15, 2006 and October 17, 2006 and incorporated herein. The rejection has been maintained for the following reasons:

Applicants state that the evidence proffered by the Examiner is inadequate to support the assertion that the seed layer deposited on the surface of a silicon wafer by PVD or CVD techniques prior to the application of electrolytic copper plating, as disclosed by Miura, is equivalent to a method for depositing a copper-containing seed layer onto a barrier material layer by an electroplating technique.

In response, Miura recites that "the electrolytic copper plating solution of the present invention reinforces the seed layer and adds thickness to the seed layer within the trenches or via holes of silicon wafers so that a highly acidic or highly basic copper plating solution, which would otherwise corrode the seed layer, can be used to plate the silicon wafer" (page 4, [0051]).

This teaching teaches that the seed layer was reinforced and thickened by the electrolytic copper plating process because if the seed layer was not, then a highly acidic or highly basic copper plating solution would have corroded the PVD or CVD seed layer.

When the subsequent electrolytic copper plating process reinforces and adds thickness to the seed layer, there is no reason why the subsequent electrolytic copper plating process is not an electroplating of the seed layer.

Applicants state that the same chemical components are maintained throughout the various steps disclosed by Dubin.

In response, the rejection is not overcome by pointing out that one reference

does not contain a particular limitation when reliance for that teaching is on another reference. *In re Lyons* 150 USPQ 741 (CCPA 1966). Moreover, it is well settled that one cannot show nonobviousness by attacking the references individually where, as here, the rejection is based on a combination of references. *In re Keller* 208 USPQ 871 (CCPA 1981); *In re Young* 159 USPQ 725 (CCPA 1968).

Applicants state that Wang clearly distinguishes between a seed layer enhancement layer and a seed layer. The Examiner has failed to show a clear and particular motivation for a skilled artisan to combine Miura and Wang.

In response, Wang teaches that deposition of the seed layer **122** is not perfectly conformal when the seed layer **122** is too thin (having a thickness of less than about 100 angstroms) when conventional PVD (plasma vapor deposition) process for the depositing the seed layer **122** is used. The seed layer **122** may be discontinuous and may not form at sidewalls and the bottom corners of the interconnect opening **104**. However, it is desired for the copper fill to be plated from substantially all surface of the interconnect opening **104** including substantially the whole surface of the sidewalls and the bottom corners of the interconnect opening **104** would have prevented void formation as taught by Wang (col. 2, lines 49-65; and Fig. 4).

This teaching would have suggested that the conventional PVD seed layer disclosed by Miura may have been discontinuous and may not have formed at sidewalls and the bottom corners of the interconnect opening. Thus, Miura reinforced and added

thickness to the seed layer using the electrolytic copper plating process, which the Examiner deems is an electroplating of the seed layer.

Applicants state that the Examiner must supply a clear and particular motivation or suggestion to combine Miura and Wang.

In response, Wang teaches that deposition of the seed layer **122** is not perfectly conformal when the seed layer **122** is too thin (having a thickness of less than about 100 angstroms) when conventional PVD (plasma vapor deposition) process for the depositing the seed layer **122** is used. The seed layer **122** may be discontinuous and may not form at sidewalls and the bottom corners of the interconnect opening **104**. However, it is desired for the copper fill to be plated from substantially all surface of the interconnect opening **104** including substantially the whole surface of the sidewalls and the bottom corners of the interconnect opening **104** would have prevented void formation as taught by Wang (col. 2, lines 49-65; and Fig. 4).

This teaching would have suggested that the conventional PVD seed layer disclosed by Miura may have been discontinuous and may not have formed at sidewalls and the bottom corners of the interconnect opening. Thus, Miura reinforced and added thickness to the seed layer using the electrolytic copper plating process, which the Examiner deems is an electroplating of the seed layer.

The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the

claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981).

II. Claim 10 has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1) as applied to claims 8-9 and 37-44 above, and further in view of **Nagai et al.** (US Patent No. 6,709,563 B2).

The rejection of claim 10 under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** in combination with **Dubin et al.** and **Wang et al.** as applied to claims 8-9 and 37-44 above, and further in view of **Nagai et al.** is as applied in the Office Actions dated May 15, 2006 and October 17, 2006 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

III. Claims 20-21 and 45-52 have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.**

(US Patent No. 6,528,412 B1).

The rejection of claims 20-21 and 45-52 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. and Wang et al. is as applied in the Office Actions dated May 15, 2006 and October 17, 2006 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

IV. Claim **22** has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1) as applied to claims 20-21 and 45-52 above, and further in view of **Nagai et al.** (US Patent No. 6,709,563 B2).

The rejection of claim 22 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. (US Patent No. 6,432,821 B1) and Wang et al. as applied to claims 20-21 and 45-52 above, and further in view of Nagai et al. is as applied in the Office Actions dated May 15, 2006 and October 17, 2006 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be

persuasive.

V. Claims **31-32 and 53-58** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1).

The rejection of claims 31-32 and 53-58 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. and Wang et al. is as applied in the Office Actions dated May 15, 2006 and October 17, 2006 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

VI. Claim **33** has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1) and **Wang et al.** (US Patent No. 6,528,412 B1) as applied to claims 31-32 and 53-58 above, and further in view of **Nagai et al.** (US Patent No. 6,709,563 B2).

The rejection of claim 33 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al. and Wang et al. as applied to claims 31-32

and 53-58 above, and further in view of Nagai et al. is as applied in the Office Actions dated May 15, 2006 and October 17, 2006 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

VII. Claim **59** has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Miura et al.** (US Patent Application publication No. 2003/0155247 A1) in combination with **Dubin et al.** (US Patent No. 6,432,821 B1), **Wang et al.** (US Patent No. 6,528,412 B1) and **Dubin** (US Patent Application Publication No. 2004/0108217 A1).

The rejection of claim 59 under 35 U.S.C. 103(a) as being unpatentable over Miura et al. in combination with Dubin et al., Wang et al. and Dubin is as applied in the Office Actions dated May 15, 2006 and October 17, 2006 and incorporated herein.

The rejection has been maintained for the reasons as discussed above.

Applicants' remarks have been fully considered but they are not deemed to be persuasive.

VIII. Claims **8-10 and 37-44** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Oskam et al.** (US Patent No. 6,309,969 B1) in combination with **Miura et al.** (US Patent Application Publication No. 2003/0155247 A1) and

Andricacos et al. (US Patent No. 6,974,531 B1).

The rejection of claims 8-10 and 37-44 under 35 U.S.C. 103(a) as being unpatentable over Oskam et al. in combination with Miura et al. and Andricacos et al. has been withdrawn in view of Applicants' remarks.

IX. Claims **20-22 and 45-52** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Oskam et al.** (US Patent No. 6,309,969 B1) in combination with **Miura et al.** (US Patent Application Publication No. 2003/0155247 A1) and **Andricacos et al.** (US Patent No. 6,974,531 B1).

The rejection of claims 20-22 and 45-52 under 35 U.S.C. 103(a) as being unpatentable over Oskam et al. in combination with Miura et al. and Andricacos et al. has been withdrawn in view of Applicants' remarks.

X. Claims **31-33 and 53-58** have been rejected under 35 U.S.C. 103(a) as being unpatentable over **Oskam et al.** (US Patent No. 6,309,969 B1) in combination with **Miura et al.** (US Patent Application Publication No. 2003/0155247 A1) and **Andricacos et al.** (US Patent No. 6,974,531 B1).

The rejection of claims 31-33 and 53-58 under 35 U.S.C. 103(a) as being unpatentable over Oskam et al. in combination with Miura et al. and Andricacos et al. has been withdrawn in view of Applicants' remarks.

XI. Claim **59** has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Oskam et al.** (US Patent No. 6,309,969 B1) in combination with **Miura et al.** (US Patent Application Publication No. 2003/0155247 A1) and **Andricacos et al.** (US Patent No. 6,974,531 B1).

The rejection of claim 59 under 35 U.S.C. 103(a) as being unpatentable over Oskam et al. in combination with Miura et al. and Andricacos et al. has been withdrawn in view of Applicants' remarks.

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

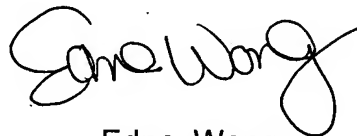
A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Edna Wong whose telephone number is (571) 272-

1349. The examiner can normally be reached on Mon-Fri 7:30 am to 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

A handwritten signature in black ink, appearing to read 'Edna Wong', with a stylized, flowing script.

Edna Wong
Primary Examiner
Art Unit 1753

EW
February 26, 2007